Space Weather Technical Forecast

Issued on Wednesday 20 November 2024 at 01:00 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: High Speed Stream solar winds bring a likelihood of enhanced geomagnetic activity from Day 2 (21 Nov).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity in the past 24 hours, with an M1.1 flare observed at the turn of the UTC day, at 19/0000 UTC, probably originating from AR3889 near the southwest limb. Otherwise, mostly background C-class flares throughout the current UTC day.

There are currently nine sunspot regions on the visible disc, one of which is a new and currently unnumbered region emerging in the northwest quadrant. The largest region, AR3889 has almost rotated around the western limb, but given its magnetic complexity this still does pose a risk of both flares and protons. AR3901 in the southeast is showing some magnetic complexity, although it remains difficult to analyse due to foreshortening, but some complex magnetic looping appears present in imagery. AR3897 near the southwest limb increased in complexity, which will be one to watch as it rotates near to the west limb. AR3898 continues to show growth with more significant umbra developing in the intermediate spots. The other regions are simple and magnetically uncomplicated.

No Earth-directed CMEs were observed over the past 24 hours in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds at L1 were mostly in a slow-regime between 340-400km/s due to a weak and waning CH92/+ and HSS influence. The solar wind density was near to below average. The interplanetary magnetic field (IMF), Bt, was weak to moderate, peaking at 10nT. The north-south component, Bz, was weak to moderately negative, peaking at -8nT, before returning to weakly positive towards the end of the period. The phi angle was mostly positive (away from the Sun). The resultant geomagnetic activity was mostly Quiet (0-2Kp), with an Unsettled interval observed at 19/1800-2100 UTC.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate levels, with a diurnal peak of 745pfu observed at 19/1355 UTC. The associated 24-hour fluence remained below the Active threshold, and the 24-hour integrated flux observed at 20/0000 UTC was 1.31e7.

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Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with the arriving regions contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Slow-Ambient winds around 350-400km/s are expected during Day 1 (20 Nov) with an increasing risk of enhancement from CH93-/CH94- which are currently near the centre disc. As a result, winds are expected to increase to Slightly elevated with speeds 450-500km/s arriving towards the end of Day 2 (21 Nov) and into Day 3 (22 Nov), gradually waning on Day 4 (23 Nov).

Quiet to Unsettled (Kp0-3) conditions expected through much of the period. Activity probably increasing through Days 2 and 3 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals, depending on the strength of any CH influences. Gradually easing to become mostly Quiet to Unsettled on Day 4 (23 Nov), as HSS influence wane.

Energetic Particles / Solar Radiation: There is a slight chance of S1/Minor solar radiation storms mainly due to AR3889 which is crossing over the western limb, but also the close proximity to AR3897 which follows closely behind AR3889, and has shown recent growth and magnetic complexity. High energy electron flux is likely to remain at background to moderate (during diurnal peaks) throughout the period. The associated fluence is expected to remaining below the Active (1e8 integrated flux) threshold.

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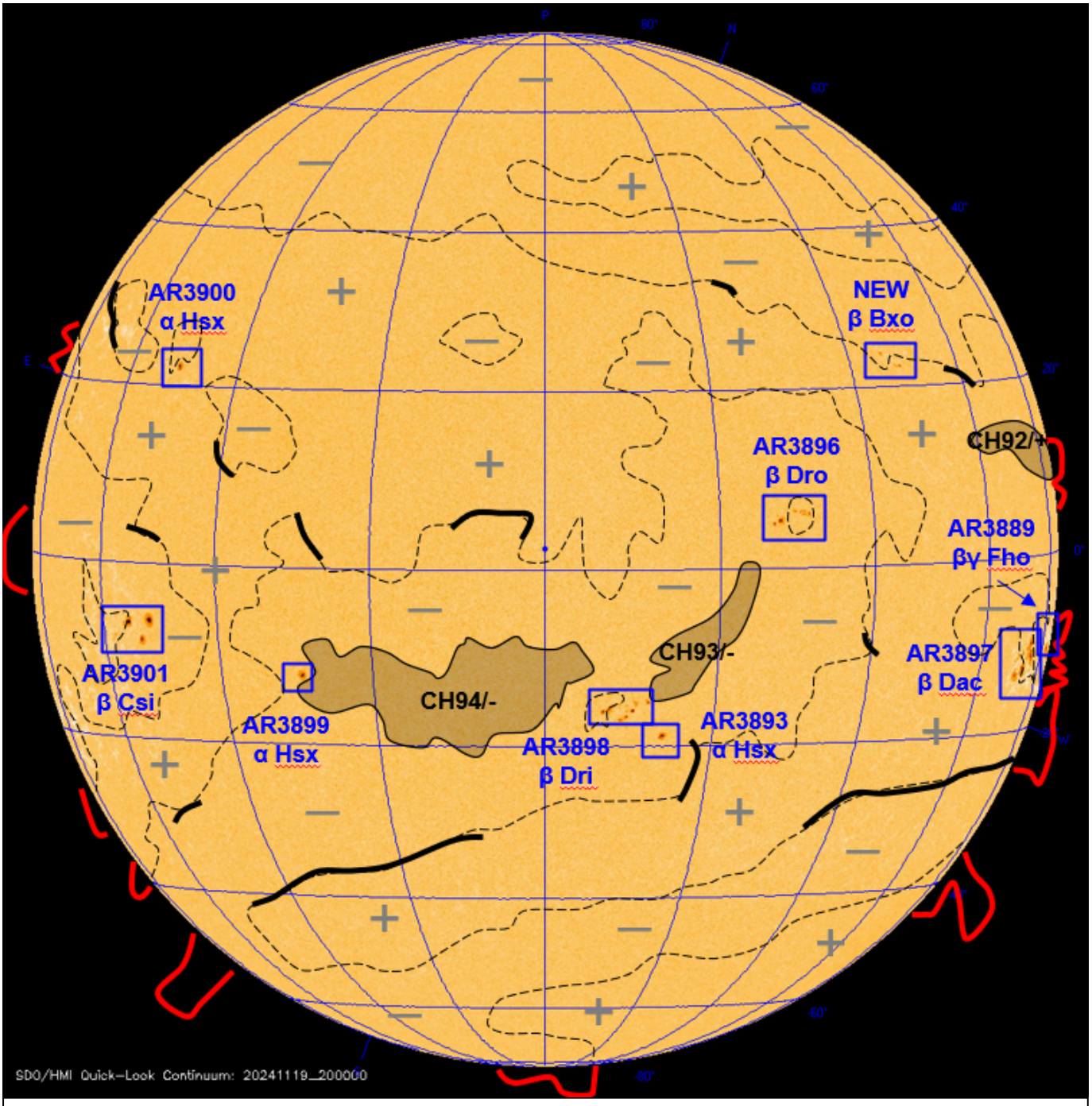
Figure 1: Solar map analysis - valid 19/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CME's in the forecast, although this can change at short notice. Especially if we see any significant filaments lifting from the Sun.

The main driver for any Geomagnetic activity through the coming period will be a connection to High Speed Streams originating from CH93-, shortly followed by CH94-. Slow-Ambient winds around 350-400km/s are expected during Day 1 (20 Nov) with an increasing risk of enhancement from CH93-/CH94- which are located near the central disc, with CH93/- crossing the central meridian into the western hemisphere. Winds are expected to increase to Slightly elevated as a result, with speeds reaching 450-500km/s arriving towards the end of Day 2 (21 Nov) and into Day 3 (22 Nov). An enhancement in solar winds to 550-600km/s is currently suggested by MOSWOC Enlil output during Day 1 (20 Nov), although this is viewed with caution, probably considered too high and too early to bring in any enhancement.

Quiet to Unsettled (Kp0-3) conditions expected through much of the period. Activity probably increasing through Days 2 and 3 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals depending on the strength of any enhancement from CH93- and CH94- and any associated CIR region. Activity gradually waning on Day 4 (23 Nov), becoming mostly Quiet to Unsettled, with isolated Active intervals, especially at first.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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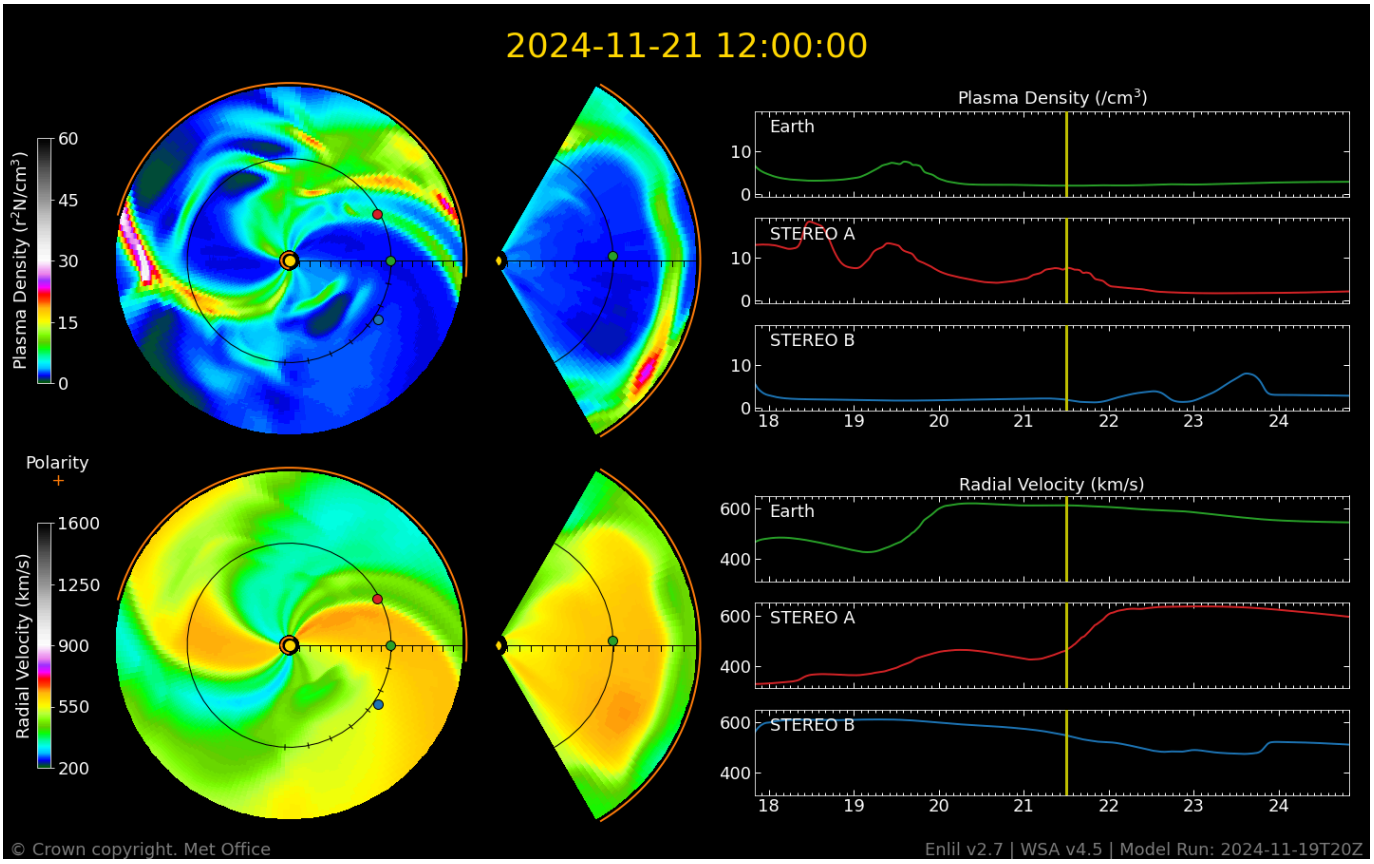
Figure 2: MOSWOC ENLIL - shows an earlier arrival of HSS from CH93/94, but currently expected to arrive late 21 Nov into 22 Nov.



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Radio Blackouts - X-Ray Flares

Currently, on the front side of the sun, there are nine sunspot regions, one of which is currently unnumbered in the northwest quadrant. The largest, AR3889 in the southwest is now rotating around the western limb, but given its history of producing M-Class flares and its continued magnetic complexity it is still believed to be a risk for Moderate flares for the next 24 hours.

Recurrence, supported by brightening and magnetic looping on the eastern limb in SDO/AIA imagery and recent far-sided CMEs, continue to suggest the potential for sunspot regions to return to the visible disc over the period. Likely the first of which has emerged across the east limb, which has been numbered AR3901. AR3901 in the southeast of the disc brought several M-Class flares through Nov 18, peaking at M3.7. This region remains difficult to analyse due to foreshortening but some complex magnetic looping appears present in imagery.

AR3898 near the centre disc in the southern hemisphere, has shown rapid development as it rotates west, which will continue to be monitored.

Overall Low to Moderate activity is expected, with the arriving regions on the east limb contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares, with the risk maintained steady through the period pending further developments. A chance of further Moderate activity and a continued slight chance of X-flares is maintained.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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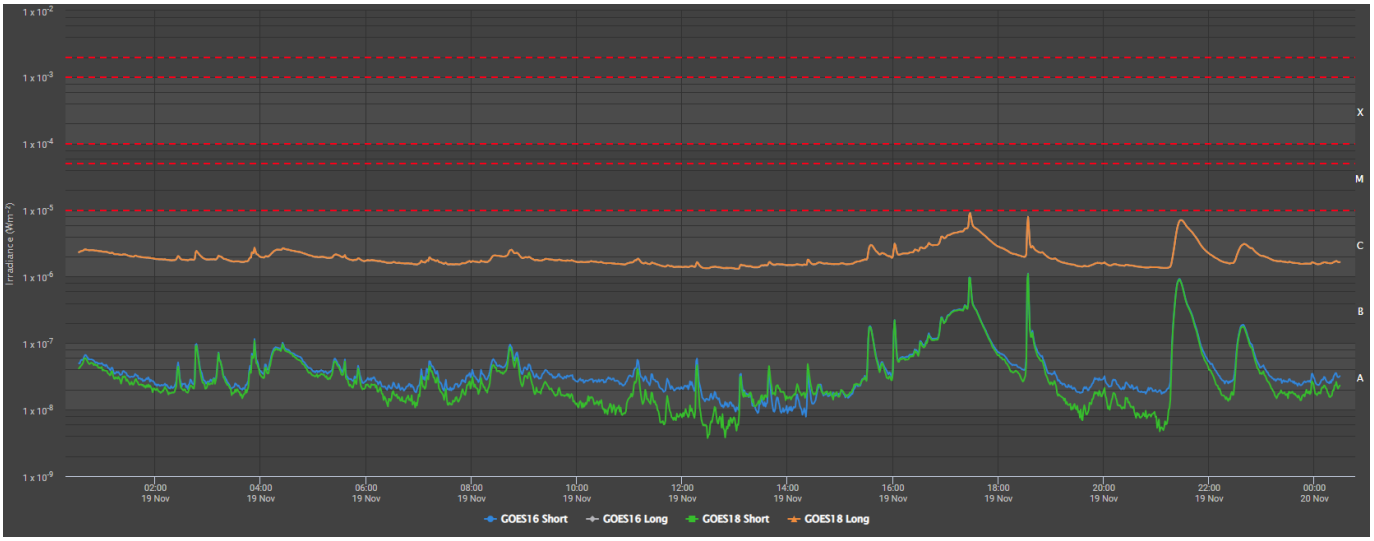
Figure 3: GOES16-18 X-Ray flux trace.



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Solar Radiation Storms (High Energy Protons)

There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from AR3889 as it approaches and rounds the western solar horizon, but also AR3897 which is following closely behind AR3889. The series of inbound eastern limb regions are unlikely to present any appreciable risk to the daily probabilities of S1 in the near term.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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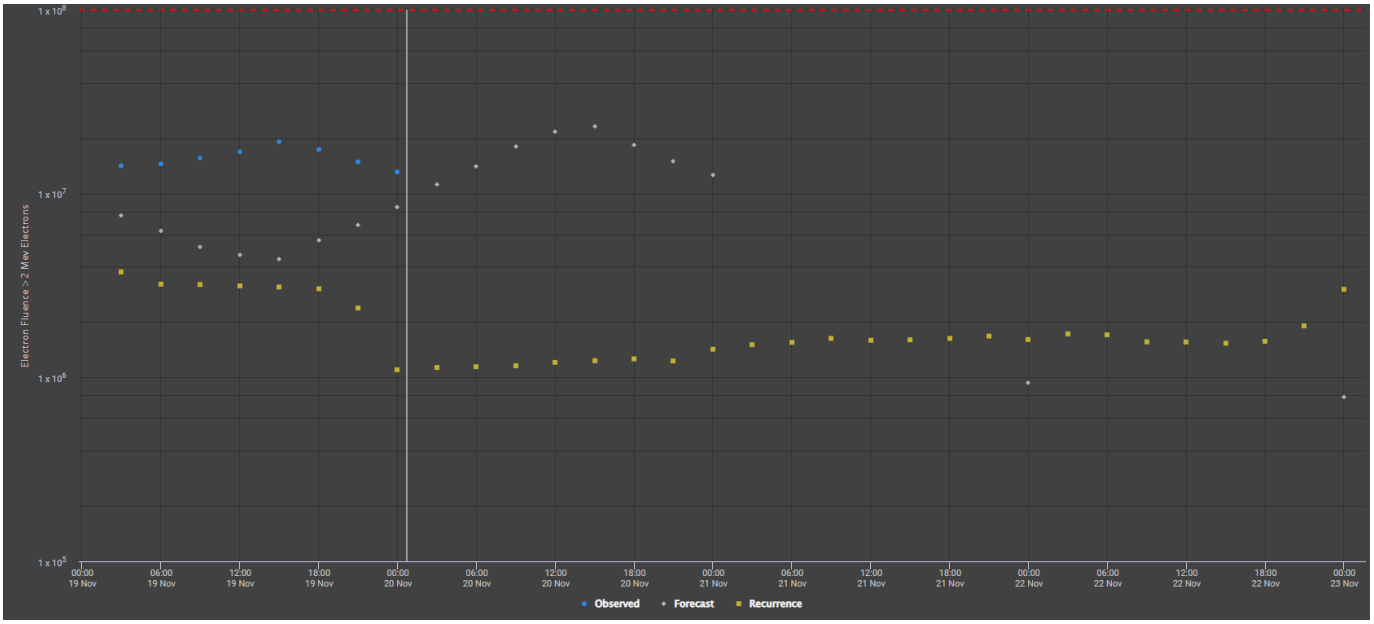
High Energy Electrons (≥ 2MeV)

Electron flux levels at GEO have been sitting in a fairly constant diurnal cycle, dropping to background levels during the overnight period (in UTC) and peaking at Moderate levels during the UTC afternoon. This pattern is expected to continue, although electrons perhaps becoming suppressed as the Van Allen belt compresses due to increased solar winds from the connection into CH93-/CH94- during the second half of the period. Following this, electrons may increase again as the Van Allen belt expands back to the location of GEO.

The initial values unlikely to be of sufficient magnitude to trouble the Active 24-hour integrated threshold - no persistent feature on the disc has resulted in Active fluence. MOSWOC REFM output viewed as providing reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence.



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